

Transformation processes towards Sustainable Industrial Estates

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Introduction

In the transformation of industrial estates towards sustainability, changes can be initiated bottom up as well from top down. The bottom up approach stands for a start within the companies forming an industrial estate with each other. They are the subject for transformation. It is logic to start on this level and create a basis for lasting transformation towards sustainability. This approach is explained in the first paragraph and focuses upon the following question: “How can we initiate and influence transformation processes toward sustainable industrial estates?”

A top down approach starts to consider the estate from a distance. We take an existing estate which we like to transform to sustainability and ask ourselves how this estate should look like in the future. There are several stake-holders involved and each of them has its own view on the development of the industrial estate. So the perspective is not necessarily sustainability with the environment as a motive. This can actually be considered as a design process which will be influenced by several stakeholders. In the second paragraph we concentrate on this design process and the possible design variants and keep the next question in mind: “How can we involve actors into transformation processes concerning industrial estates?”

It is not excluded that both bottom up and top down approaches can be started as a transformation process toward sustainability. The bottom up approach starts small regarding the subject directed to the environmental care in and locally constrained to the stakeholder called “companies”. The top down approach for transforming an industrial estate is broad: sustainability forms one of the perspectives providing a design variant and more stakeholders are involved. The interesting question is where and how do both approaches meet each other. Or preferably, from which level are both transformation processes to be initiated. In the third paragraph we pay attention to the question: “What are the opportunities for steering transformation processes of industrial estates, such as revitalisation, towards sustainability?”

All three paragraphs are based upon the experiences with recent and ongoing projects at the Centre for Clean Technology and Environmental Policy (University of Twente).

Production processes, management and networks

Looking at the subject “environment” in and round companies over the last years, we can see a tendency that a company searches for co-operation with other companies or partners for a further reduction of their environmental burden. A company utilises, sometimes felt obliged, more and more their business network to improve their environmental performance. We can distinguish several stages.

During the first stage a company is directed to its internal activities. The “surroundings” is not yet recognised as opportunity. In The Netherlands this process of

internal improvements and environmental management started at the end of the eighties, begin of the nineties. At the national level the Government Memorandum on Environmental Management was lying at the basis¹. Companies were pointed out on their responsibility for the environment, which was not only constrained to an “end-of-pipe”-approach as in the previous decade. Their responsibility ought to be directed to the core activities within the factory, that means their production processes. In the Netherlands this was the starting signal for pollution prevention projects² and the implementation of environmental management systems. The role of pollution prevention is to reduce the actual emissions and waste streams. The environmental

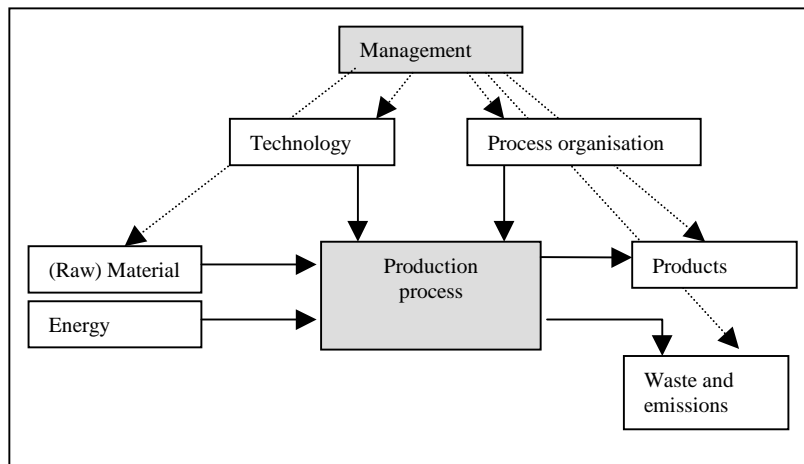


Figure 1 Input-output model

management system is to take care and to steer the activities on pollution prevention. All activities, from product design via the production processes to the end products, should get sufficient attention, see Figure 1 for a schematic reflection.

The inputs ‘energy’, ‘(raw) materials and other resources’, ‘technology’ and ‘process organisation’ and the outputs ‘products’, ‘waste streams and emissions’ on the other hand, form the entries for pollution prevention measures and options. The same entries are used by the management to monitor and steer the production processes properly and possibly certified according to the ISO-9000-series (quality system). We can speak of a environmental management system if at the regarding entries environmental criteria are taken in consideration: this means periodically (in cycles) and with the goal to improve environmental performance.

Soon appear from environmental point of view that a company and its production process operates not separately, but forms one step in a chain from raw resources to products which in the end comes available for consumers. Via the same consumers it ends up in the chain of waste handling. The environment functions as, which was clear for a long time, the starting point as well as finishing post. A company can utilise the chain of production processes to reduce its environmental burden. This second stage quickly followed and went along with the in-company developments on environmental issues³. It is an obvious step to take. A company uses its existing network of suppliers and buyers, also companies, and stimulate and mobilises them to manage the production chain for environmental purposes⁴. We extend the activities in the field of pollution prevention and environmental management to a so-called environmental chain management, see figure 2.

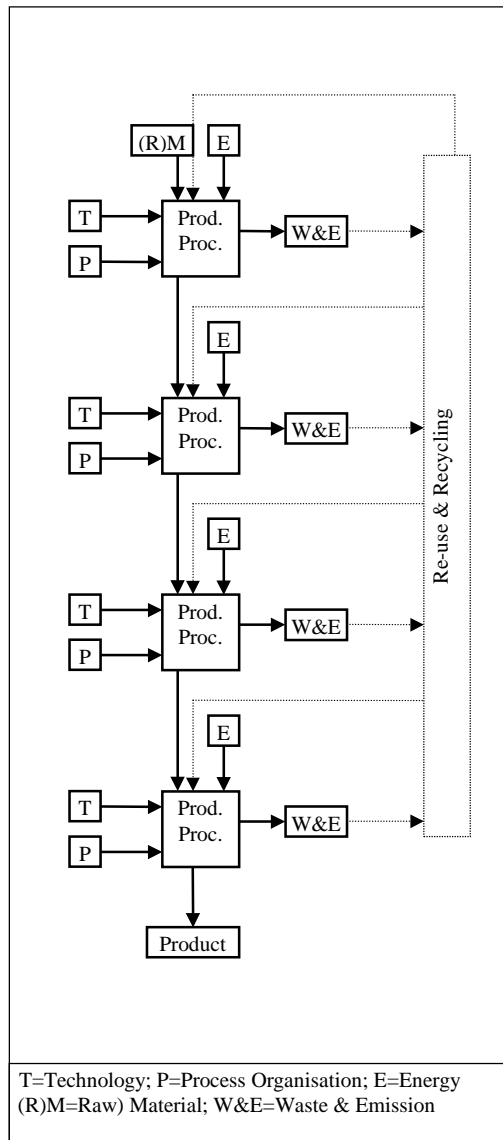


Figure 2 Environmental Chain Management

material and energy cascades like the (re)use of (waste)water and energy.

If we restrict ourselves to industrial business-like connections, the last stage is a far-reaching integration of chain management (the vertical connections, figure 2) and the sustainable industrial estates (the horizontal connections, figure 3). This will happen if industrial estates make contact for co-operation. The origination of such network is, in my opinion, what we can be understand as “industrial ecology”. It is the network where streams of (raw) materials and products integrates with the stream of rest and waste materials aimed at the closing of industrial cycles.

With the question “How can we initiate and influence transformation processes toward sustainable industrial estates?” we refer to the development of a local network of companies within a certain territory (third stage).

We recognise the entries and apply them in the same way as we did before. In this way we can, for instance, improve the environmental performance for company A by taking measures in company B. Where in the first stage the advantages for company B were zero or negative, with chain management the net advantages can be positive in economic or environmental point of view.

For better environmental performance due to chain management a company utilises his existing network of business connection and its accompanying material and energy streams. For the development of a sustainable industrial estate a company needs to build up a new network with locally settled companies. The goal of such network is to connect material and energy streams with each other on a local level and to improve the environmental performance of the industrial estate. This is the third stage for a company to undertake activities by stimulating and mobilising its neighbours and search with them after win-win-options on a local level. From the point of view of material and energy streams this is schematically reflected in figure 3.

On local basis this comes under the theme “sustainable industrial estates”. This needs not only to be restricted to the local scale of an industrial estate. It is also possible to extend the scale to a region, if we are looking for

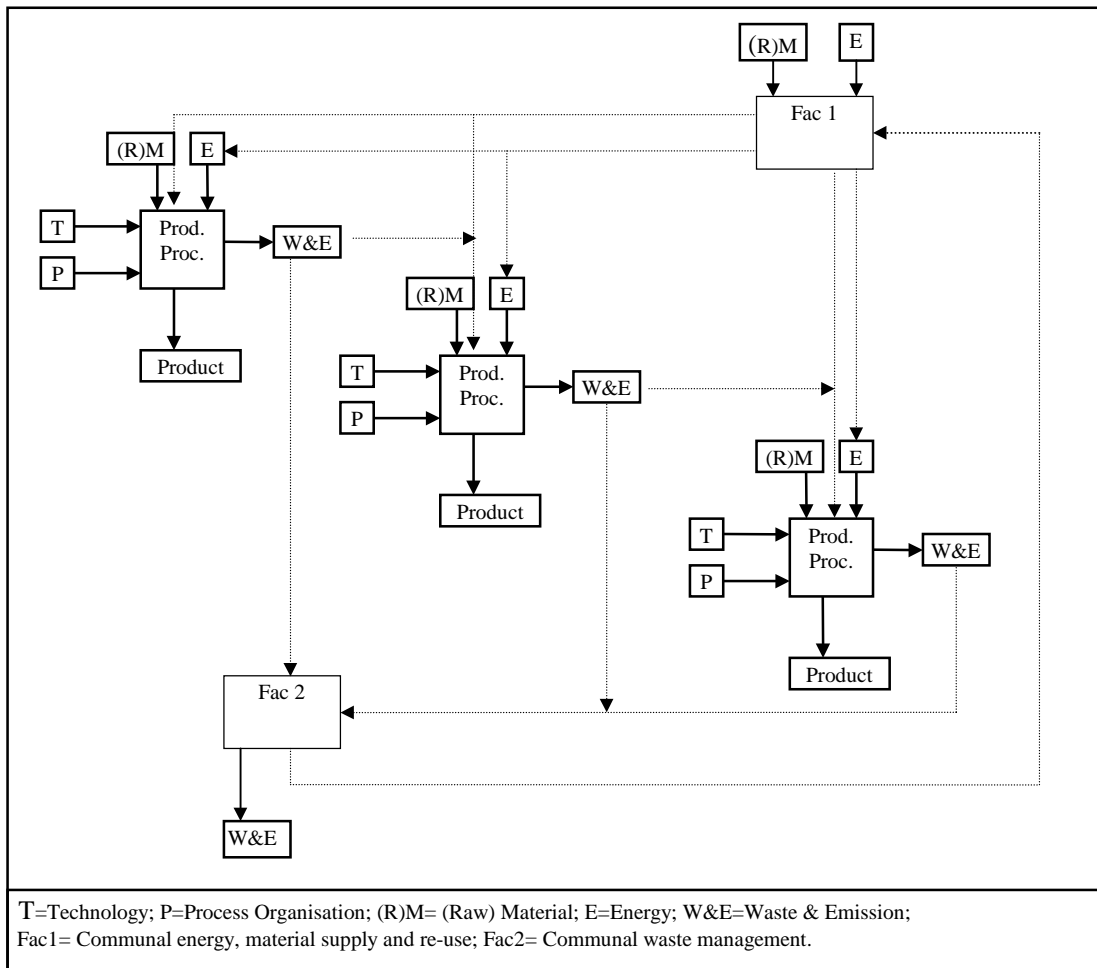


Figure 3 Environmental management on an industrial estate

Recently we started a project with the CCTEP with the purpose to build up such network from company level. The smallest unit in this network is a company and by surveying its material and energy streams and make connections with local firms, you could speak of a bottom up approach. The goal of the project⁵ is bipartite:

- Research to optimise the material and energy streams on an existing industrial estate aimed at improved environmental performance.
- The development of a management structure for the industrial estate to keep searching for optimisations of its material and energy streams.

The execution course of this project knows two tracks. The first track is directed to analyse the companies and individually consult them on internal issues. We can see this track within the framework of the first stage: inside company activities on pollution prevention and environmental management. For small and medium sized companies developments are still going on. On the other hand there is a estate directed track. Here we search for win-win-possibilities and stimulate the participating (of) companies.

The methods for analysing and consulting an individual company on environmental issues are the known and proven methods for pollution prevention. This methods also gives us the data which are relevant for making connections between companies. On the outgoing side it is relevant to know the possibilities for separated collection of waste and rest fractions: What are the rest fractions and waste (water) streams and

which quantities are involved? How is the quality and fluctuations of those streams? On the incoming streams we can put the type of questions concerning quality and quantity: What do companies need and what are specifications to answer to? In the end it turns out if and where can put collective facilities and initiate co-operation between companies as schematically shown in figure 3.

An important additional goal which comes along with the bottom up approach is the communication aspects. In this kind of project it is important to create a basis for the long term. We can also utilise this basis to stimulate co-operation between companies on other fields then the environment. This involves for instance the top down approach (see the next paragraph) and the management structure for an industrial estate (see the third paragraph) from which we can initiate transformation processes that goes beyond environmental issues.

An industrial estate as design variant

We consider a design variant to be a plan how to develop an industrial estate with clear specifications on a final result. Besides the aspects of spatial planning it also contains organisational aspects for the management of the estate. If we like to transform an industrial estate to a sustainable one, we will take the starting and external conditions which lead to a design or plan that gives fully expression to sustainability. However there are more variants possible designed from different point of views and interests. Every stakeholder has his own perception on the development of an industrial estate and will try to influence transformation processes to his own benefits. Each stakeholder can come up with its own design variant. The compromise is the one variant in which all perceptions are sufficiently represented.

A design strategy is a way to approach this issue of coming to a representative plan to transform an industrial estate. This approach is followed within an other project by the CCTEP.

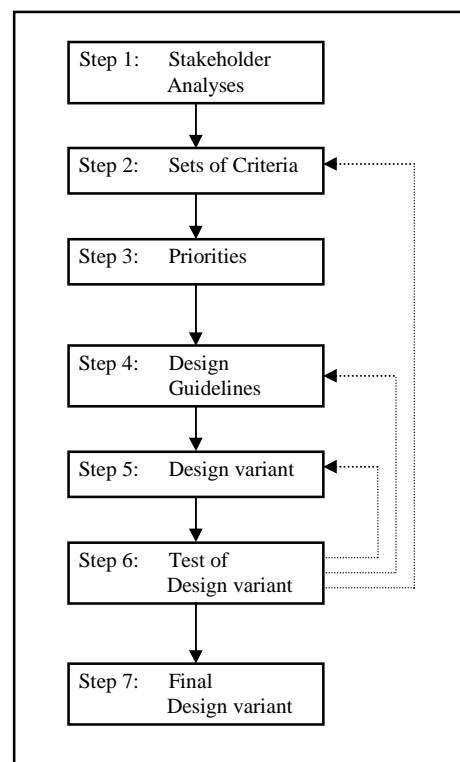


Figure 4 General design scheme

The objective of the project was “to come up with a general design scheme to be used for the transformation of industrial estates towards sustainability”⁶. The transformation of an industrial estate, either or not sustainable from an environmental point of view, will take a series of decisions and activities. The issue is to find out and search for the crucial moments for the decision making and how to take all stakeholders into account. The general design scheme is schematically represented in figure 4. It is based on a specific case, namely the Eem and Waal harbour which is part of the Rotterdam harbour area.

Stakeholders play a central role in this scheme and they are to be analysed in the first step. Each stakeholder has his interests , experiences the results of and makes demands on the transformation process to a redesigned estate. First there are the persons and organisations directly involved: persons (citizens), companies and

organisations within and the surroundings of the area, and the municipal organisations. Except of these stakeholders also other parties are indirectly involved and possibly like to influence process of decision making. Stakeholders are for example chambers of commerce, branches of industry, central government and action groups.

Analysing the stakeholders is first to determine the parties involved. Secondly we survey the perception and the interests of each stakeholder on the estate to be developed or transformed. Later on it is important that the perceptions and the interests of the stakeholders are to be found again in the final design variant. The next step is to translate the interests of each stakeholder into sets of criteria. These sets are to be used to test upon one or more variants. The skill with this step is the translation of an interest into a measurable criteria. Notice that the interests is are not equal according to there importance, but have different priorities. Within a set of criteria belonging to a stakeholder a specified arrangement can be made due to their weight and relevance. The final result of the second and third step is that we can award each stakeholder with a set of measurable and weighted criteria.

To get an idea how the first steps can be done, is briefly illustrated in table 1 for the Eem and Waal harbour in Rotterdam. From the ample ten stakeholders recognised for this area, the three most relevant ones are analysed. These are the settled companies, the citizen living in the Eem and Waal harbour (a residential area is located) and the municipal authorities as representative of environmental aspects and spatial planning. Table 1 gives the interest of each stakeholder and the translation to criteria (and guidelines).

Table 1 From stakeholder to design guideline

Stakeholder	Interests	Criteria	Measurable criteria (guidelines)
Companies on the industrial estate	Optimal circumstances for economical development	Space for business activities	Square meters business area per square kilometre;
		Wet and dry infrastructure	Depth of fairway; Parking facilities
		Storage room	
Citizens (residential area)	Liveability	Physical quality of housing;	
		Security	
		District Facilities	Number of sports facilities
		Accessibility	Number of connections to surrounding (high) ways;
Environment; Municipal authorities	Sustainable Development	Communal energy facilities	Number of participating companies per 10 companies.
		Communal waste management	
		Reduction of waste and emissions	Kilograms emission of substance A
		Revaluation of natural parts	Square meters greening per square kilometre.

Remark: the table is not exhaustive and is meant to get idea how to work out the sequence “stakeholder-interest-criteria-(guideline)”.

The several sets of criteria gives us the rules or guidelines for (re)designing an industrial estate. In this stage (step 4) we stop to make a distinction between the stakeholders and integrate the sets of criteria to one pack of criteria. We formulate them in terms of design guidelines for the regarding estate. The integration process forms the bottleneck in the scheme: can all criteria sufficiently be translated to guidelines? Some criteria will be contradictory, others will overlap and strengthen each other. On the basis of the guidelines we can turn to the redesigning of an existing

industrial estate or design a new one.

The design variant ensued from step 4 will not immediately be the final variant. It is better to test the variant by applying the several sets of criteria. This test with measurable criteria gives us a score for each stakeholder and as a result the abnormality or deviation from each ideal variant. This deviation can become too large or unbalanced when we compare the stakeholders involved. In this case we have to search for the source for the deviation in the previous steps:

Are the perceptions and interests of each stakeholder sufficient translated to criteria? (step 2)

Are the guidelines (the “total pack” of criteria) a well-balanced representation of all sets of criteria and its priorities? (step 4)

Are the guidelines properly applied? (step 5)

In the beginning this iteration process probably takes a lot of time. Considering the novelty of the design scheme there not much experience. By applying the design scheme on several industrial estates bottlenecks will appear from this iteration process and the way to resolve them. The built up of experience will or has to lead to a more optimal use of the scheme aimed to minimise the tests and the iteration process. If this succeeds, the design scheme has right to exist: we can practical directly set up a satisfactory final design variant out of the guidelines.

In the case of the Eem and Waal harbour the bottleneck lay in the translation from the sets of criteria to the design guidelines. Initially the three stakeholders were treated separately. For each stakeholder we worked out a design variant and then look for similarities and resolve contradictions. We came to the conclusion to overcome this issue earlier by following the steps outlined in figure 4.

The management of an industrial estate

The initiative for setting up a new industrial estate initially will be taken by the municipal authorities. They look after the interests of the local community. To set up and build up new industrial estates is part of the policy on the social-economic development and spatial planning. After pointing out the territory, the municipality starts to emit plots and companies can settle. The next task and responsibility of the municipality is a proper course when the estate is build up, like the opening up of the area, granting building and environmental permits. On the long term the municipal activities shift towards maintenance tasks. Maintenance implies the monitoring of the policy on spatial planning, renewal and checks on granted permits and the physical maintenance of the public area (roads, sign posting, public greening, etc.).

A industrial estate also knows a life cycle⁷. After some time, years to a decade, an estate can become dated with becoming pauperized as next stage. Delayed maintenance of roads and public greening, bad maintained buildings and plants and vacancy are the characteristics of such estate. Revitalisation is the term we use for the process of the revival and renewal of an industrial estate. However preventive proceeding is better. That is to say: keep on stimulating an estate in his development or better, let them do it themselves. The approach of revitalisation versus prevention differs not really. The difference is only in the starting-points. The core issue is the quality of the industrial estate with questions like: How do I get an industrial estate to a desired quality level? And how do I save or improve this quality level?

The present companies determine to an important extent the quality of an industrial estate. If a municipality likes to (preventively) revitalise, they need the co-operation of the present companies. In the past the municipal role was directed to monitoring and regulating. Nowadays with the (re)build up of new and existing estates, a municipality should direct themselves more on structured co-operation with companies. The basis for this kind of process is a management plan with the following elements⁸:

- A description of the desired quality level (policy);
- A plan with measures (projects) to reach the required quality level;
- Agreements and procedures (=organisation) to save and improve the quality level.

The agreements and procedures implies an organisation, like a corporation, concerning the co-operation between the municipality and companies and companies mutually. We can speak of revitalisation if a the municipal authorities and companies can give substantial contents to the second point dealing with maintenance and restructuring an estate. Working out the items mentioned above, all parties get clearance about the goals (policy), the way it will take place, how the tasks are divided, how agreements and procedures are made (organisational form) and where the financing is coming from.

If we look at the desired quality level then we can immediately link this to the design variant and the design scheme in previous paragraph. A final design variant forms a compromise of all the stakeholders involved and can be described, as far as this is not already done, in quality demands. In this way the top down approach can fit into the plan with measures to reach the required quality level. Probably the management of an industrial estate is the initiator to (let) search for the desired variant for an industrial estate (existing or new) according to the design scheme.

One of the pillars implying a part of the quality demands, is sustainability from the stake-holder's point of view "environment". Working out the sustainability aspect for the management plan we can use the document made by the Dutch Ministry of Economic Affairs. They published a manual for the development of sustainable industrial estates titled "Sustainable industrial estates, a manual for the management of companies and government"⁹. One of the perspectives in this document is the "sustainable fit out an industrial estate". They have divided this theme in four parts:

- Efficient and intensified utilization of space on an industrial estate;
- Build up of energy and water facilities with high returns;
- Build up of company directed commercial facilities;
- Multi-functional transport and improved public transport services.

The business world, in this case the companies on the estate, needs the (municipal) government to develop these items by formulating them into quality demands. We have to notice that a municipality is not one stake-holder, but from several perspectives. Important ones in this case are the social-economical development and the environmental issues.

Moreover the items mentioned embroider on a second perspective in the manual. This second point of view, "sustainable business processes", is also divided in four parts:

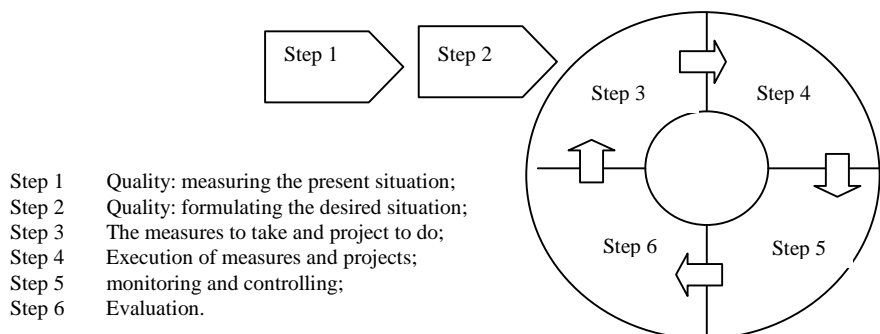
- Exchange of energy, materials and water;
- Joint use of company facilities;
- Cooperative collection and transport of waste;

- Transporting combinations of goods and persons.

In this case the mutual collaboration of companies can give contents to these items independently from the government. This matches with the bottom up approach in first paragraph. Companies leave this exclusive domain of mutual co-operation when “Exchanging energy, materials and water” and “co-operative collection and transport of waste” become “Building up of energy and water facilities with high returns” and influence the other functions on the industrial estate (“building up of cooperative commercial facilities”). When this happens co-operation with the municipal government is required. In this way the bottom up approach will contact the top down approach: already started comparative projects between companies can fitted in a design and subsequently in a management plan for an industrial estate.

A structured and smooth course is desired. Some kind of organisation on the level of the estate is required. This piece of organisation is needed to initiate and implement projects and supervise the transformation processes ensued from this activities. The basis for such an organisation can be found in the so-called public-private collaboration between the municipal government and an interest group representing the companies on an estate. We come across the last question we like to answer: “What are the opportunities for steering transformation processes of industrial estates, such as revitalisation, towards sustainability?”.

The way to form a public-private collaboration directed to a management structure can be done by the following steps visualised as a cycle with preamble activities ¹⁰:



The preamble steps, especially the second step, are comparable with the design activities from the previous paragraph. In this case we start on a more modest level by formulating measurable quality demands.

In the cycle we also recognise the common method to improve the quality management within a company, usually indicated as “Deming-circle”. This Deming-circle means the set up for the so-called “plan-do-check-act”-cycle. The management systems in accordance with the ISO 9000-series (for quality) and the ISO 14001-standard (for environment) are in fact the instruments to make the Deming-cycle “waterproof”. In this case we lift the method to the organisational level of the estate. However doing so we face the following new issue: the management of the industrial estate involves more than one party. It is not only the co-operation between the municipal government, but also the mutual co-operation of companies. It is clear that we have to deal with barriers hindering an efficient co-operation and management¹¹. Within a company the management can impose organisational facilities to improve the common steering of

production processes and the management systems for conditions of employment and environment. This is not the case for an industrial estate: organisational facilities are based on negotiations. The development of park management as steering instrument is on voluntary basis. One can see this negatively as a barrier for initiatives and transformation processes. On the other hand you can also see this positively as a challenge. A challenge for partners, municipality in co-operation with companies, to form such a structure and don't leave it with loose projects.

So the transforming an industrial estates directed to sustainability is not the question *if*, but more *how* business and (local) government will form a public-private co-operation. In this way a municipality can get influence on the facilities initiated by companies, certainly when this relates to the spatial planning. On the other hand the quality of the estate will also be determined by, for instance, spatial planning aspects. If companies decide to improve the quality of their estate, is logical they get more and direct influence on municipal policy concerning the development of industrial estates.

Conclusion

Looking at the activities needed to develop an industrial estate toward sustainability as one of the leading themes it is necessary to strengthen the network on and around the area. This refers to the companies and their more close co-operation on environmental issues from a bottom up approach. On the other hand a municipality should participate stronger in this network. Not so much as a executor of the law (like granting a permits) but act more like a partner. As one of the most important local stakeholder (from several point of views), they are the initiator to establish a design variant for an industrial estate (top down approach).

The final goal is that the parties involved will formalise their co-operation in this network by public-private organisational structures mentioned in the last paragraph. This is not constrained to the theme sustainability only, but is also to extent to other themes. So activities to develop a sustainable industrial estate can best be initiated by public-private co-operation between the municipal authorities and an interest group representing the companies on the estate. Interesting questions for the future are:

- To what extent can and will the municipal authorities change their internal organisational structure to adjust in aid of mentioned co-operation? To what conditions does a municipality have to agree if they like to participate?
- How can a new or existing interest group grow into a full partner within a public-private co-operation? Or does such interest group just form the organisational basis for such co-operation?

¹ Tweede Kamer der Staten Generaal, Bedrijfsinterne Milieuzorg, Vergaderjaar 1988-1989, 20633 nr. 3.

² Hoo, S. de e.a., "Handleiding voor preventie van afval en emissie" (Manual for Pollution Prevention), SDU uitgeverij, Den Haag, 1990.

³ Cramer, J., e.a , "Theorie en praktijk van integraal ketenbeheer" (Theory and practice of environmental chain management), Nationaal onderzoeksprogramma hergebruik van afvalstoffen, 1993.

⁴ Kolk van der J., e.a., "Milieugericht ketenbeheer door bedrijven" (Environmental chain management, a manual for businesses), Samson H.D. Tjeenk Willink, 1995.

⁵ Ongoing project of the CCTEP on an industrial estate in Enschede (Netherlands), 1999.

⁶ Flamma, J.W., e.a., “Visie op duurzame bedrijventerreinen” (Vision on sustainable industrial estate), Rapport voor Tauw, 1999.

⁷ Nagel, R., e.a., “Nieuwe kansen voor bestaande terreinen” (New chances for existing industrial estates), Heidemij in opdracht van Volkshuisvesting, Ruimtelijke Ordening & Milieubeheer, 1996.

⁸ Burghouts, A., e.a., “Opstellen van beheerplannen voor bedrijventerreinen” (Set up management plans for industrial estates), workshop in opdracht van Provincie Overijssel, 1998.

⁹ “Duurzame bedrijventerreinen, handreiking voor het management van bedrijven en overheid” (Sustainable industrial estates, a manual for the management of companies and government), in opdracht van Economische Zaken, 1998.

¹⁰ See note 8.

¹¹ Hofman, Peter & Matton Theo, Removing barriers for sustainable industrial estates, paper at the Environmental Training in Engineering Education, 1998.